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AN

INTRODUCTORY LECTURE,

DELIVERED BEFORE THE

MEDICAL CLASS

OF

Hampden Sydney College,

RICHMOND, VA.

October 30, 1843,

BY S. MAUPIN, M.D.

PROFESSOR OF CHEMISTRY AND PHARMACY.

(PUBLISHED BY THE CLASS.)

G. W. HOPKINS, PRINTER,
Main-Street.

RICHMOND MEDICAL COLLEGE,
November 6th, 1843.

Dear Sir,

The Students of the Medical College have entrusted to the undersigned Committee, the agreeable duty of soliciting for publication, at as early a day as convenient to yourself, a copy of the able Introductory Lecture delivered before them at the opening of the present Session. Independent of the gratification they anticipate from its perusal, they are confident that its wide dissemmination will be productive of happy results upon the prosperity of our cherished Institutions. We avail ourselves of this method of placing before you the wishes of ourselves and fellow-Students, taking occasion to add, the assurance of our high respect and esteem.

D. SUTTON,
J. T. FORBES,
THOS. E. COX,
L. B. ANDERSON,
C. J. F. BOHANNAN,
Committee.

To S. MAUPIN, M. D.

Richmond, Nov. 7, 1843.

Gentlemen—I have to acknowledge the receipt of your communication requesting, on behalf of the Medical Class, a copy of my Introductory Lecture for publication.

The lecture was prepared without any view to its publication, and I am fully sensible you estimate its merits too highly in requesting a copy for that purpose. As I do not feel at liberty however, to disregard the wishes of the Class—it shall be placed at their disposal.

Be pleased to assure the gentlemen you represent of my grateful sentiments towards them. Thanking you for the flattering terms in which you have communicated their wishes,

I am very truly,

Your friend and obedient serv't,

S. MAUPIN.

Messrs. D. Sutton,
J. T. Forbes,
Thos. E. Cox,
L. B. Anderson,
Ch. J. F. Bohannan,
Committee, &c.

NATURAL Science has for its object a knowledge of matter in its momentary states of existence, and of the laws which regulate the changes it undergoes. The ultimate principles from which spring the forms and changes of matter are perhaps few, but to ascend to them is beyond the power of finite capacities. All that we can do in acquiring a knowledge of Nature, is to observe, describe, and classify forms—to detect, as far as possible, the sequences in the changes of matter—in other words, to ascertain relations of cause and effect, and from the results of a limited number of observations and experiments, to ascend to general laws. This point attained, we may speculate on the conditions upon which these laws are probably based, and propose theories for their explanation, a process to which the mind is so exceedingly prone that we might infer *a priori* that it is one of the conditions of success in investigating the hidden truths of nature. The History of Science, in fact, abundantly sustains such inference. We admit that speculation previous to the time of Lord Bacon, to whose age the revival of philosophy is properly referred, led enquiries far astray from truth, and together with the influence of *authority*, opposed the greatest barrier to the successful pursuit of science. But this was because men speculated without a sufficient number of facts to guide them. Like the great river of geographers whose course, laid down from one or two points of observation, was at length swallowed up in the sands of the desert, so their theories ended in the barren regions of error, and failed to carry them forward to the great ocean of truth. In modern philosophy, however, facts have been first observed and recorded, their connexions ascertained, the laws which regulate their occurrence developed, and speculation guided by these sure lights, has opened new roads to investigation, suggested new methods of interrogating nature, and led to discoveries the most interesting and important.

The object of Natural Science, we have said, is a knowledge of nature in all its circumstances and changes. It divides itself into two great divisions: Natural History, which describes animate or inanimate bodies as they are found to exist—and Natural Philosophy, which describes the changes they may undergo and the laws which regulate them. Certain striking differences in the subjects considered, together with reasons of convenience, have given rise to numerous subdivisions: Thus Mineralogy, Botany, and Zoology, according as the subjects of enquiry belong to the mineral, vegetable, or animal kingdom, form distinct branches of Natural History, and Natural Philosophy is subdivided into Physics, Chemistry, and Physiology, according as the changes, the phenomena, and laws of which are studied, take place at appreciable or inappreciable distances, or belong to organic or inorganic bodies. Again, Physics, Chemistry and Physiology have their subdivisions. The facts which fall under each branch may be noticed, recorded and studied, but as all the departments of Science are but branches of a great parent stem, it is obvious that none of them can be studied to advantage without a general knowledge of the rest. Facts full of interest may present themselves to a mind accustomed to regard nature in limited aspects, and yet its unpracticed vision may fail to detect their richness and value. To be properly appreciated they must be comtemplated from many different points of view, and in the full radiance of the circle of knowledge. Such is the connexion of the sciences that a great progress in one is often the result of investigations in another, and discoveries frequently shed less lustre on the branch to which they properly belong than upon kindred branches.

Towards the close of the last century Science was wonderfully enriched by the discovery of Galvanism. The celebrated Volta was early engaged in proving its identity with electricity, and by the invention of the Voltaic pile succeeded completely in his efforts. His experiments were regarded

with intense interest throughout Europe, and scientific men were engaged every where in verifying and varying them. Messrs. Carlisle and Nicholson were the first to repeat Volta's experiments with his own apparatus. They ascertained that the zinc end of the pile was positive, and the copper end negative. In making some experiments with the pile, they by accident brought a gold wire communicating with the copper extremity, in contact with a drop of water upon the upper zinc plate. With surprise they observed that air bubbles were extricated from the water. Cavendish had already established synthetically, and Lavoisier analytically, that water is composed of two gases, oxygen and hydrogen. Messrs. Carlisle and Nicholson were therefore led to suspect that in their experiment water had been decomposed and its constituent gases eliminated. They repeated their experiment with this modification. A gold wire was connected with each end of the pile and their free extremities plunged into a glass of water, but so as not to touch each other. A gas was extricated from each wire. They were collected, and upon examination proved to be, the one oxygen, and the other hydrogen, in the proper proportions for forming water. On mixing them, they were fired with explosion by the electric spark or flame, and completely converted into water. Thus the decomposition of water by the agency of the pile seemed to be fully demonstrated.

This remarkable result, indicating a connexion between electrical and chemical forces previously unsuspected, almost transcended belief. Analytical Chemistry had made too little progress to inspire universal confidence in the composition of water, as established by Cavendish and Lavoisier, and certain accidental phenomena which accompanied its decomposition by the pile, to wit, the appearance of an acid at one pole and of an alkali at the other, created great perplexity and confusion of ideas amongst that class of chemists who had not the discrimination to seize upon the principal fact, nor the ingenuity, skill, and perseverence, to disembarrass it of accessories.

Thus Ritter maintained that water was not decomposed at all by the agency of the pile—that the gas which appeared at the negative pole, and was known to chemists by the name of hydrogen, was in reality nothing but water combined with positive electricity, and the oxygen which appeared at the positive pole, the same fluid combined with negative electricity. In consequence of these electrical charges the gases were attracted to their respective poles, and when mixed and inflamed the electricities combined with explosion, and ordinary water was reproduced.

The appearance of an acid along with the oxygen at the positive pole, and an alkali with the hydrogen at the negative pole led others into errors that would not have been discreditable to the adepts in Alchemical Science. They inferred from these results that water could be changed into an acid and an alkali.

In this state of confusion and obscurity Davy commenced his investigations of the subject; and it required an effort of genius such as he possessed to dissipate the clouds with which it was invested. He directed all his powers to its elucidation, bringing to his aid precautions so rational and so minute, a zeal so constant, with a sagacity and ingenuity so exquisite, and crowning the whole with a success so complete and so remarkable, as to invest the history of his labours with an inexpressible interest.

In studying the effects of the pile upon water, Davy at once recognized the decomposition of this fluid as the great and leading fact. With other experimenters he observed the appearance of an acid at the positive pole, and an alkali at the negative. The acid was found to be hydrochloric, and the alkali soda. The union of these bodies, it was well known, produced chloride of sodium, or common salt. By an examination of the glass vessels employed, he detected a minute quantity of chloride of sodium, yet sufficient to account for the formation of the hydrochloric acid and soda observed in his experiments. Vessels of Agate were substituted. But these too were found to furnish materials for the decomposing agency of the pile. Finally he employed vessels of gold as least liable to be attacked by this wonderful instrument. He still met with an acid and alkali as in previous experiments; but the acid was the nitric acid and the alkali, am-

monia. Thus one difficulty seemed to be substituted for another. But that which might, to ordinary minds, have clothed the subject in more impenetrable obscurity, was to the penetrating glance of Davy the source of new illumination. In every experiment oxygen and hydrogen appeared at their respective poles—water was incontestably decomposed--so, also, was the chloride of sodium in the original experiments. But the nitric acid and ammonia—whence did they arise? Not from any compounds of these substances previously existing in the water or vessels. They must have been the result of some synthetic agency of the pile. Their elements indeed were supplied from water itself, and from atmospheric air from which it was impossible completely to free it. Yes, Ammonia composed of Nitrogen, and hydrogen, and Nitric acid, composed of nitrogen and oxygen,compounds which it is exceedingly difficult, if not impossible to form by the direct union of their constituents, were readily produced by the agency of the pile—an agency sufficiently powerful to destroy, on the one hand, combinations previously existing, and on the other, to cause their elements to obey new attractions, and form new compounds.

How vast the career which these wonderful results opened to the mind of Davy! With him the conclusion was irresistible, that as by electrical forces compound bodies are decomposed, so by Electrical forces their elements are united. This principle admitted, the possibility of decomposing all compounds, with a pile sufficiently powerful, was a necessary consequence. With enthusiastic ardour he brought into requisition every means for verifying the correctness of this conclusion. Galvanic apparatus of greater and greater power was procured. Sulphate of Lime, Sulphate of Strontia,and many other compounds yielded to its decomposing agency: and finally the well known alkalis, potash and soda, gave up their metallic bases; an analytic result the most brilliant of the present century, remarkable for the means by which it was effected, and eminently important for the light it shed upon an extensive class of compounds. Franklin when by a bold and ever-memorable experiment, he had established the identity of Electricity and Lightning, is said to have heaved a sigh and sunk upon the ground with overwhelming emotions. The grandeur of the result, at the moment of its realization, was too immense for calm contemplation, though surveyed by an intellect mighty as his. What emotions then must have swayed the mind of Davy, endowed with genius and imagination and filled with the spirit of poesy, when the conception of the identity of electricity and chemical affinity seemed established by facts, and the whole system of nature in her secret workings seemed exposed in undecked simplicity before him? We may not appreciate them, but we can imagine their intensity when the scientific world hailed the discoveries which were the fruits of his speculations with a universal cry of enthusiasm.

With Davy the particles of dissimilar bodies when brought into contact became charged, the one with positive and the other with negative electricity, and when the intensity of the dissimilar charges became sufficiently great, they coalesced in consequence of the attraction of the two electricities. At the moment of union these fluids having served their purpose were neutralized—giving rise to the phenomena of heat and light, so generally recognized in chemical changes; the resulting compound being maintained by the force of cohesion, or that general attraction which is admitted to exist between all bodies in nature. When a compound was brought under the influence of the electric currents of the Voltaic pile, the charges were restored to its elements, whereby they became subject to the attraction of poles oppositely charged, and this attraction overcoming cohesion, decomposition was effected. Such was the simple theory advanced by Davy for the explanation of chemical union and decomposition; a theory not only consistent with every chemical fact known at the time, but productive, as we have seen, of the most important discoveries. True the progress of discovery has caused it to be modified. But with all the scrutiny of propound and varied research its foundations have never been undermined, and it yet rears its proud head among the loftiest beacons of science.

The history of which the outline has just been presented illustrates the connection, often intimate, of the different branches of science. A fact

accidently brought to light in the prosecution of researches in galvanism, arrested the attention of a man of genius, in whose hands it became the instrument of a most astonishing progress in chemistry. Nor is this the only occasion upon which the latter has brought to its aid the treasures of other departments of knowledge. The offspring of the decline of ancient civilization and learning, and nursed for ages in the lap of semibarbarism, it is only since the middle of the last century, that she has emerged from her unpromising infancy, and asserted her claims to the admiration and gratitude of mankind. Though slow in assuming her rank in the sisterhood of sciences, she has nevertheless in her progress towards maturity, had the advantage of distinguished embellishments from her seniors in that attractive coterie.

Dalton, in the year 1808, advanced his theory of the atomic constitution of bodies, a theory, the promulgation of which Berzelius has pronounced the "greatest step which chemistry has made towards her perfection."

The united labours of chemists has developed three fundamental laws of chemical combination :—

The first is that the composition of bodies is fixed and invariable—that is—so long as a body retains its characteristic physical and chemical properties—its constituents remain the same, and maintain the same relative proportions.

The second, which may be regarded as a corollary of the first, is, that the proportions in which bodies combine, may be expressed by numbers.

And the third—that when bodies unite in different proportions, so as to form different compounds, the quantity of one of them remaining the same in each, the quantity of the other enters in some simple multiple of of that which exists in a first combination.

These laws, the result of a wide induction from facts, are regarded as among the best established principles of the Science. To Dalton is due the merit of giving them an intelligible expression, and indeed to him exclusively, are we indebted for the establishment of the third.

In seeking for an ultimate fact which might account for these laws, the idea occurred to Dalton, that all bodies are made up of atoms or particles infinitely small and indivisible. With this postulate every thing was explained. The elements which form a compound unite by the juxta-position of atoms. The same number of atoms, in the same relative proportions, and with the same arrangement, being requisite to form the most minute particle of a compound, its constituents must remain invariably the same, so long as it retains its characteristic properties. Make any change in the kind proportions or arrangement of the atoms, and a new compound would result. Suppose, in the second place, that the atoms of the different kinds of matter have specific weights, and the law of proportional numbers is explained—and lastly, when bodies unite in different proportions, grant that one or two atoms of the one combine with one, two or three or more atoms of the other, so as to form a first, second, third, and fourth compound, and we have an explanation of the law of multiple proportions.

Such was the atomic theory of Dalton. It is perfectly consistent with all the phenomena of quantitative analysis, and chemists have derived such important aid from it in exhibiting chemical changes, in anticipating the results of chemical action under new circumstances, and in extending the chemical nomenclature, that it has been universally adopted. Still, as it came from Dalton's hands, it was only an hypothesis. He did not prove that bodies are made up of minute indestructible atoms, nor has chemistry hitherto furnished any incontestable proof that such is the case. True, the beautiful explanation which the theory furnishes, of the well established laws of chemical combination, has been appealed to in proof of the existence of indivisible atoms. But a demonstration of this kind is inadmissible. Admitting the infinite divisibility of matter, by mechanical forces, which the ancients contended for, there is no difficulty in supposing that the divisibility by chemical forces has a limit, and that it is between masses reduced to this limit that affinity is exercised. All the phenomena of chemical affinity are as consistent with this supposition as with the hypothesis of indivisibility as an essential property of these masses.

Could the ultimate fact upon which Dalton's theory rests be fully esta-

blished—could we discover any instrument by which reason might dissect matter to its most minute atoms, and expose their hidden nature and movements, what a career of discovery would open before us—to what sublime truths might we not expect to ascend! The molecular movements might then perhaps be subjected to calculation, and the reactions of bodies under given circumstances predicted with as much certainty as the occurrence of eclipses or other phenomena of the solar system. The imagination may extend its flight to this state of perfection, but the track by which it is to be reached is yet unexplored. Observations have already been made to establish the point of departure, but they have been made beyond the domains of chemistry, and with instruments with which she is not familiar.

The atmosphere which surrounds our earth is a gaseous body, which expands and diminishes in density as the distance from the centre of the earth increases. Two causes conspire to this effect—the attraction of the earth, which decreases as the squares of the distances increase, and the repulsion between the particles of air. This latter force diminishes as the distance between the particles increases. Now, on the supposition that the particles of matter are not infinitely divisible, there ought to be a term at which the two forces would be in equilibrium and this term would be the limit of the atmosphere. If on the other hand, matter is infinitely divisible, the particles of air as rarefaction increases, ought to divide and subdivide, by the inherent force of repulsion, into parts more and more minute, upon which gravitation would exert less and less power. No limit could be reached at which the two forces would balance each other. The atmosphere ought consequently to extend throughout space, and collecting around the heavenly bodies, form atmospheres for them, proportional in density to their masses.

The determination of the question of the finite divisibility of matter seems dependent therefore on the solution of this problem. Is our atmosphere limited in extent, or have the Sun and planets atmospheres? To what principle in physics shall we appeal for its solution? Wollaston availed himself of the refraction of light. Light, in its passage through a vacum or a transparent medium of uniform density, pursues in its course a direct line; but in passing from one medium to another of a different density is bent from its straight direction, and approaches the perpendicular to the surface of the medium into which it is entering. This bending or breaking of the direction of the ray of light, is called *refraction.* In viewing objects, we refer their situation to the direction in which the rays of light proceeding from it, enter the eye. If these rays have undergone refraction, the object will appear in a different situation from that which it really occupies. Now, suppose a planet at the period of conjunction to be so situated as to suffer an eclipse from the Sun, it is evident that as the eclipse approaches, the rays of light proceeding from the planet would, in their course towards the earth, traverse the atmosphere of the Sun, if such atmosphere exist, and from the effect of refraction the begining of the eclipse would not occur at the precise moment of the time determined by calculation.

M. Vidal, in the year 1805, without any particular object in view, made observations at Toulouse, upon the planets Mercury and Venus at the times of their eclipses, and Wollaston and Kater repeated them in the year 1821 upon Venus, for the purpose of elucidating the question of which we are now speaking. These observations showed a perfect co-incidence between the apparent and calculated times of the eclipses. The apparent and calculated movements of Jupiter's satellites have likewise been found to coincide. Observation has indicated no discrepances, such as might be referred to refraction produced by an atmosphere surrounding the primary planet. The inferrence from these data is, that the sun and planets have no atmospheres, and therefore the atmosphere which surrounds our Globe must be limited in extent: a result which would seem inconsistent with the infinite divisibility of matter.

Thus, Astronomy and Optics lend us the means of making the nearest approach to a demonstration of the fact assumed by Dalton as the founda-

tion of his theory. It is proper to state however that Dumas objected to the inference in favour of the doctrine of atoms, drawn from the finite extent of the atmosphere, He has advanced the idea that the cold produced by rarefraction at very great heights above the earth's surface may be so intense as to reduce the atmosphere to the liquid or even solid state, whereby it would be effectually limited, and it would be unnecessary to suppose an equilibrium of attractive and repellant forces acting upon indivisible particles or atoms. The suggestions of Dumas are ingenious, but too fanciful to unsettle conclusions drawn from the operation of well established physical laws.

The doctrine of Atoms occupies great space in modern chemistry. It harmonizes perfectly with every fact upon which it can have any bearing, not only in Chemistry but in the whole range of science. Indeed so important an instrument of discovery has it proved, and so indispensable is it in the present state of knowledge that to set it aside would be productive of scarcely less confusion than the displacement of the doctrine of gravitation from the modern system of Astronomy.

Crystallography, a department of Natural History to whose progress and perfection the labours of Rome de l' Isle, Hauy and Weiss have so signally contributed furnishes another illustration of the benefits conferred upon Chemistry by collateral sciences.

Gay Lussac observed that crystals of potash alum when introduced into a solution of ammonia alum, continued to increase without modification of form, and conversely. In this way perfect and regularly formed crystals might be obtained, consisting of alternate layers of the two compounds. M. Beudant afterwards noticed a similar fact in regard to the sulphates of iron and copper. Now analysis had already shown a similarity of composition between ammonia and potash alums, and between the sulphates of iron and copper. Mitscherlich was struck with these correspondences, and after extended observations of the same nature, was led to the conclusion that "the same number of atoms combined in the same manner, produce the same crystalline form: and the same crystaline form is independent of the chemical nature of the atoms, being determined only by their number and relative position." A conclusion which though not establisbed in all its generality, is inconsistent with no certainly known fact. The term *Isomorphism* has been applied to this relation in form between similarly constituted bodies.

The law deduced by Mitscherlich has proved of very great interest and importance from the light it has shed upon Chemistry anh Mineralogy. It has suggested to the Chemist the composition of bodies not previously examined, and has guided him in his analytic investigations. A body to be examined is found to affect a crystalline form similar to one already carefully analyzed,—its atomic constitution is at once conjectured—and the difficulties of analysis become thereby abridged in an important degree.

To the mineralogist it has explained how isomorphous Elements may intermingle and even replace each other in the same mineral without altering the crystallive form. Thus, in the garnet, which as ordinarily met with is a compound of Silicate of Alumina and Lime, the alumina is sometimes found replaced entirely or in part by peroxide of Iron, and the lime, by magnesia or by protoxide of Iron—still the garnet, in all these cases, preserves its proper crystalline character—A circumstance for which no satisfactory explanation could be given, and which indeed was thought to militate against the doctrine of definite proportions, until the discovery of isomorphism fully illucidated it.

We have occupied your attention with a few general illustrations of the aids which Chemistry has derived from other departments of science—it would be interesting to look upon the other side of the picture, and contemplate the benefits she has conferred upon kindred sciences and the glorious achievements she has been the instrument of effecting in the arts. The Panorama is too extensive to be surveyed in detail on the present occasion, and we content ourselves with passing in brief review some of the contributions chemistry has made to Physioligy or the science of life.

One of the most interesting subjects of physiological inquiry is the cause of animal heat—Chemical action is almost invariably attended with the evolution of heat, and this phenomenon is particularly remarkable when-

ever Oxygen enters into combination with other substances. In our common fires the heat liberated is due to the union of oxygen with the fuel. Dr. Black discovered that Carbonic acid is eliminated from the lungs during respiration, and subsequent experiments proved that about an equal volume of oxygen disappeared from the inspired air—The temperature of animals was also found to bo proportional to the quantity of air breathed in a given time. From these data is was inferred that venous blood arrived at the lungs, charged with carbon; that the carbon there combined with the oxygen of the inspired air, so as to form an equal volume of carbonic acid, which was given out with the exspired air; that by this combination animal heat was produced, and venous became converted into arterial blood. But a radical objection to this theory of the cause of animal heat has always been the difficulty of accounting for its uniform distribution to all parts of the system. If animal heat is generated in the lungs, the temperature ought to be greatest there, and diminish gradually towards the extremities—which is not the case. Crawford attempted to remove the difficulty by considerations founded on the unequal capacities for heat of venous and arterial blood. According to him, arterial blood had a greater capacity for heat than venous. The heat produced by the combination of oxygen with carbon, in the process of arterialization, supplied this increased capacity without elevating the temperature. But when in the capillary ramifications of the vessels, the arterial became again converted into venous blood, this heat was liberated and thereby a uniform temperature maintained throughout the system.

This Theory, though ingenious, has been shown by subsequent investigation to be entirely unsatisfactory and inadmissible. Dr. John Davy ascertained that the difference between the capacities for heat of arterial and venous blood is much less than Crawford supposed, and altogether too inconsiderable for the explanation based upon it. The experiments of Brodie were likewise adverse to the theory. He found that when artificial respiration was kept up in animals after decapitation, though the circulation continued and carbonic acid was separated, the heat diminished more rapidly than in dead animals in which the respiration was not kept up. Brodie referred animal heat to the nervous system as its source. But Chemists and Physiologists have generally agreed in referring it to respiration: though the mode in which a uniform distribution of temperature is brought about, remained a mystery until the genius of Liebig drew aside the veil and exposed it to the light.

La Grange and Hassenfratz years ago maintained that carbonic acid is not produced in the lungs, during the act of respiration, but generated in the course of the circulation—that it is merely given off in the lungs, whilst an equal volume of oxygen is absorbed. Their views did not extend however to the source of the carbonic acid, or the manner in which the oxygen entered the circulation—whether it was simply dissolved or entered into combination with some of the constituents of the blood. Now these are the points upon which Liebig has enlightened us. The coloring matter or red globules of the blood are known to contain iron, a substance not found in the serum or fibrin, nor indeed in any constituent of the body, and which is remarkable for the facility with which its compounds with oxygen pass one into another by absorbing or giving up a portion of this element. The iron in the venous blood exists in the state of carbonate of the protoxide. When it reaches the lungs it meets with oxygen introduced through the thin coats of the vessels by the process of Endosmoee. The oxygen seizes upon the protoxide and converts it into peroxide of iron: at the same time the carbonic acid, which cannot remain in combination with the latter, is given off and escapes with the expired air. By this change the blood is arterialized, and circulating to every part of the system, conveys the peroxide of iron to yield oxygen to certain constituents of the body in its passage through the capillaries. One of the chief products of the oxidating process there going on, is carbonic acid, which taken up by the venous blood, combines with the iron reduced to the state of protoxide, in its passage back to the heart and lungs where the same series of changes commence anew. Thus, says Liebig, " in the animal organization two processes of oxidation are going on: one in the lungs, the other in the capillaries. By means of the former, in spite of the degree of cooling, and of the increased eva-

peration which takes place there, the constant temperature of the lungs is kept up, while the heat of the rest of the body is supplied by the latter."

This theory rests upon well-attested observations and takes account of every phenomenon of animal heat. A constant combustion is going on in the system, for which the fuel is supplied, partly by the organs of the body in the perpetual process of their waste, and partly by the nutritious substances taken into the system for the purposes of re-production. In the absence of food, the fuel is supplied from the stores already in the system—from the fat in the first instance, and then from the brain and other organs. As these are consumed the sufferer becomes emaciated, and finally dies with symptoms of delirium. With external cold the internal waste becomes more rapid, and hence the difficulty of resisting the conjoined influence of cold and hunger. With a proper supply of food the equilibrium of waste and reproduction is maintained, and the normal state preserved. But the quantity and quality of this supply depend not only upon the circumstances of the individual as to age, health, and occupation, but also upon the climate he lives in. In children nutrition must exceed waste. A greater proportional supply of food is requisite for them than for adults—Combustion is more active and animal heat greater.

Liebig has rendered it probable that muscular motion and every function of the body is attended in its exercise with certain definite changes of composition in the appropriate organs. The waste under exercise is greater, and hence a greater supply of food and more active respiration are necessary to operate the requisite changes. The inhabitant of the torrid zone is satisfied with a moderate supply of vegetable food, which nature produces in abundance with little labour on his part. The temperature of the external air is high, and little food and exercise are requisite to keep up the supply of heat from within. The occupant of colder climates requires animal food in addition, and is forced to more active exertions to supply his daily wants—whilst the dweller in the frozen north pursues the chase and swallows large draughts of train oil with eager pleasure, Admirable adaptation of man to circumstances! Beautiful illustration of the wisdom and goodness of Deity! Striking proof of the simplicity of the means He employs to operate his wise and benevolent purposes!

"The moment," says the younger Herschell, "we contemplate nature as it is, and attain a position from which we can take a commanding view, though but of a small part of its plan, we never fail to recognise that sublime simplicity, on which the mind rests satisfied that it has attained the truth." The Theory of respiration we have just noticed places us upon one of these commanding positions. Nothing could be more beautiful, more satisfactory, more fruitful in important results, or more rich in promises for the future. It is a contribution of surpassing interest to physiology, yet it is but one of the rich offerings which the genius of Liebig has drawn from the domains of Chemistry, and made subservient to that important science.

Lavoisier revolutionized inorganic Chemistry and established its principles upon immutable foundations. Liebig has commenced a similar service for organic Chemistry Each has established an era in science. The former gave an impulse to investigations in one direction whilst the lapse of more than half a century has been insufficient to exhaust. The latter with a creation of ideas of his own, has directed the energies of science in a new path: and that path the most interesting of any upon which human reason has hitherto travelled, for along it lie the hidden springs, the mysterious operations of organic life itself.

Gentlemen we may mistake the signs in the horizon, but a great light seems to be dawning upon physiological and pathological science—that light is to rise from Chemistry. By the prosecution of enquiries such as Liebig has commenced the theory of the functions in health and disease will be better understood: and though no great revolution in medical practice may be the consequence, the emperical stores of knowledge acquired by the experience of ages, will range themselves under general laws, and the physician will understand better in what disease cousists and why it is that his remedies produce their well known effects.

But we will not pursue this subject farther—we have already trespassed too long upon your patience. In conclusion Gentlemen, permit me in the

name of my colleagues, and for myself to welcome you again to our halls. You have come amongst us to prepare yourselves to enter upon the walks of an honorable and responsible profession. Ample provision has been made to meet your wants in all the departments of that profession—Anatomy and Physiology, Surgery and Surgical Anatomy—Pathology and the Practice of Medicine in its two leading divisions—Materia Medica and Therapeutics—Chemistry and Pharmacy form the curriculum of studies. Nothing need be said on the present occasion of their respective claims. They will be more ably presented by my colleagues who are to follow me at this desk. Each branch forms an essential part of a medical education. Need you be told that each will demand your earnest, labourious and faithful attention? No one-sided culture will fit you for the duties you will hereafter be called upon to perform. If a general acquaintance with the circle of sciences furnishes such essential aids to the successful cultivation of each, as we have endeavoured to show by illustrations bearing upon that which it will be our duty to teach in the succeeding lectures—surely an intimate acquaintance with each department of medical science is all-important to the Physician. Lay broad and deep then the foundations of your knowledge and go forth from our halls prepared to encounter disease in all its forms and to combat it with the appropriate weapons.

A word concerning ourselves and we have done. Six years ago the establishment of a medical school in the metropolis of Virginia was projected by members of the present Faculty. The state of things then existing seemed favourable to the design. On referring to the statistics of the Medical Department of the University of Pennsylvania it was found that it had graduated about 3,000 students, from the period of its foundation up to 1836 of whom about 1,000 or one third of the whole number were from Virginia. It was ascertained that about 300 students from Virginia were annually attending Medical Lectures, 250 of whom resorted to instiutions beyond the limits of the state, greatly to the prejudice of her pecuniary resources. In many points of view it seemed an object of high importance to provide for their education at home. To attain this object however, the state could not be looked to in the first instance. The wants of the medical profession were too far removed from the ordinary concerns of the mass of society to attract the attention of the legislature, unless brought before them by a simultaneous movement and co-operation on the part of the Medical Faculty of the state which it was hopeless to expect. To private enterprise therefore was left the establishment of a medical institution adequate to all the wants of the medical student. Richmond from the extent of its population, its centraility and accessibility from every direction, its general salubrity and social advantages seemed peculiarly elegible for the location of such an institution. Accordingly the Medical Department of Hampden Sydney College was established here in the winter of 1837 and in October 1838 its first course of lectures commenced. The Faculty in founding it have encountered many difficulties necessarily incident to an enterprise of such magnitude dependent for its success upon their private resources and individual efforts. Yet in spite of these difficulties and in the face of opposing interests and prejudices the institution has steadily progressed in public favour. Successive winters have seen our halls more and more numerously attended—encouraged by these indications we have pressed onward with ardent zeal, in our undertaking, and now after a period of five years, after the completion of a lustrum, we have the satisfaction of feeling and knowing that we are no longer engaged in a doubtful experiment, Should our reasonable expectations of legislative aid be fulfilled, the institution must at an early period attain a high degree of prosperity. But whether future legislative action towards it, be swayed by enlightened views of expediency and economy or the reverse, the question of its permanency is settled. Its continuance is based upon this sure foundation that it supplies an important want of a great state, the means of a thorough medical education in all its branches practical as well as theoretical. We are just commencing the sixth year of our labours. We enter upon them encouraged on every hand by favourable omens—by past success, by cheering present indications, and by that harmony in our own body which is a pillar of strength in any cause.